Biomineralization of Nonsilica Elements by Diatoms

Andrew K. Boal
Institute for Astronomy
University of Hawaii, Manoa
Physical Sciences Building Room 213
2565 McCarthy Mall
University of Hawaii, Manoa
Honolulu, HI 96822
USA
akboal@ifa.hawaii.edu

Mark V. Brown
Institute for Astronomy
University of Hawaii, Manoa
USA

Lysa J, Chizmadia
Institute for Astronomy
University of Hawaii, Manoa
USA

Eric Gaidos
Department of Geology & Geophysics
University of Hawaii, Manoa
USA

Diatoms are unicellular algae that are ubiquitous in marine and freshwater environments and which posses a unique cell wall, the frustule, composed of silicon dioxide. The frustule is constructed via a silicon metabolic pathway, comprised in part by a class of proteins called silifins that catalyze the hydrolytic polymerization of environmentally available silicic acid. Due to their predominance in aqueous environments, diatoms largely control the environmental processing of silicon prior to its incorporation in sediments and linking biogeochemical cycling of carbon and silicon. Silicon has been an important minor element in the world oceans, particularly since the Eocene rise of grasslands, but concentrations may have been much lower on the early Earth as well as in the hypothetical extraterrestrial oceans with different compositions such as that of Europa In such a scenario, silicon may be replaced by an element with similar chemical reactivity and utility, such as tin or titanium, and thus diatom-like microorganisms may evolve to fill a similar environmental niche in the cycling of this element. To explore this premise, we have recently begun an investigation which will address three questions: 1) can diatoms grow frustules out of materials other than silicon dioxide when the culture medium they are grown in is depleted in silicon and enriched in an element chemically similar to silicon? 2) What is the catalytic activity of frustule associated proteins on the *in vitro* hydrolytic formation of non-silicon metal oxides? 3) What are the environmental distributions of proteins involved in silicon metabolism?